

SPECIFICATION NO. 1-337-2-70

FOR TWO MOTOR GENERATOR SETS, TRANSFORMERS AND  
ASSOCIATED SWITCHGEAR

1. SCOPE

1.1. This specification covers the provision of two motor generator sets, transformers, associated control and distribution gear.

2. CODES AND STANDARDS

2.1. Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of codes and standards listed in Detailed Specifications.

2.2. Conflicts:

a. Between referenced codes and standards: code or standard establishing more stringent requirements shall be followed.

b. Between referenced codes and standards and specifications and/or plans: one establishing more stringent requirements shall be followed.

2.3 Codes and standards of following organizations are referenced herein.

a. National Electrical Manufacturers Association (NEMA).

b. United States of America Standards Institute (USAS), (American Standards Association - ASA).

3. GENERAL DESCRIPTION - M-G SETS

3.1. Furnish two motor generator sets, auto transformer reduced voltage start with associated controls, and required metal clad switchgear for generator main breaker and feeder breakers, in accordance with these specifications, and the one line diagrams, Drawings No. 1-337-70, sheets 1&2. All equipment must be manufactured within the United States.

4. GENERAL REQUIREMENTS  
DRAWINGS AND INFORMATION

4.1. Within thirty calendar days after award of Contract, submit to the Contracting Officer preliminary out-

line and arrangement drawings for each piece of equipment, including following information:

- a. Overall dimensions and weights.
- b. Locations for floor channels.
- c. Locations for conduit openings in floor.

4.2. Submit additional shop drawings as follows:

- a. Certified outline and general arrangement drawings.
- b. Complete elementary diagrams including three-line diagrams of all potential and current secondary circuits showing device terminal numbers and internal diagrams.
- c. Schematic diagrams of all control and alarm circuits.
- d. Complete wiring diagrams of equipment showing connections of all component devices and equipment.
- e. Material lists.
- f. Operating and instruction manuals.
- g. Parts lists.

5. MATERIALS AND WORKMANSHIP. All materials and parts comprising the set shall be new, of current manufacture, and of high grade, free from all defects and imperfections. Workmanship shall be in accordance with good modern industrial practices.

5.1. Protection against corrosion: All exposed items such as bolts, screws, nuts, washers, and other small parts shall be of an approved corrosion resisting material, or shall be suitably treated to resist corrosion.

- a. Corrosion Resistant Treatment: A uniform coating of sufficient thickness of cadmium, chromium, copper, nickel, silver, or zinc is approved corrosion resisting treatment.

- b. Dissimilar metals: Contact between dissimilar metals which would cause deterioration of parts by galvanic corrosion shall be avoided wherever practicable.

6. SAFETY. All exposed parts that operate at extremely high temperatures of that are energized electrically, and all rotating or reciprocating parts that are of such nature or so located as to become a hazard to operating personnel shall be insulated, fully enclosed, or properly guarded.

7. VIBRATION ISOLATORS. Provide vibration isolators suitable to mount unit on a smooth concrete pad.

8. MOTOR.

8.1. Type: synchronous, brushless, air-cooled.

8.2. Standards: conform to USAS (ASA) Standards C50.10-1965 and C50.11-1965.

8.3. Rating:

a. Hp: 330 and 40

b. Speed: 1,500 or manufacturer's standard.

c. Voltage: 2,400

d. Phase: three

e. Frequency: 50 hertz

f. Power factor: unity

g. Duty: continuous

h. Temperature rise: 80°C based on 50°C ambient.

i. Overload capacity: 10 percent for one hour.

8.4. Mechanical features:

a. Bearings: double, sleeve with temperature indicators and automatic continuous lubrication.

b. Enclosure: open, drip-proof.

8.5. Electrical features:

a. Insulation: Class B

b. Excitation: rotor-mounted brushless exciter provided with means of automatically applying field excitation at the most effective pull-in point.

Synchronizing point shall be adjustable. Field excitation system shall be removed automatically whenever motor is out of step.

9. GENERATOR.

9.1 Type: high performance, synchronous, brushless, air-cooled

9.2 Standards: conform to USAS (ASA) Standards C50.10-1965 and C50.13-1965.

9.3. Rating:

- a. Kilowatts: 250 and 30
- b. Speed: 1,800 or manufacturer's standard.
- c. Voltage: 230 Delta for 250kw, 120/208 wye for 30kw.
- d. Phase: three
- e. Frequency: 60 hertz.
- f. Power factor: 0.8
- g. Duty: continuous.
- h. Temperature rise: 70°C based on 40°C ambient.
- i. Overload capacity: 10 percent for one hour.

9.4 Mechanical features:

- a. Bearing: double, sleeve.
- b. Enclosure: open, drip-proof

9.5. Electrical features:

- a. Insulation: Class B.
- b. Excitation: rotor-mounted brushless exciter.
- c. Neutral grounding: unit shall be suitable for operation with solidly grounded neutral.

10. VOLTAGE REGULATOR.

10.1. Type: three-phase sensing, solid state, Zener

10.2. Performance requirements:

- a. No-load to full-load voltage regulation  $\pm 1$  percent
- b. Steady state voltage band width:  $\pm 3/4$  percent
- c. Maintain above performance for  $\pm 5$  percent deviation from rated frequency.

10.3. Control: provide adjusting rheostats, switches and other devices required for both manual and automatic control.

10.4 Location: mount in metal-clad switchgear specified hereinafter.

11. MOTOR CONTROLLERS.

11.1. Type: fused, magnetic, reduced voltage auto-transformer type with isolating switch and draw-out circuit contactor, NEMA Class E2 for control of synchronous motor.

11.2. Standards: conform to NEMA Industrial Control Standard IC1-1965, Section III, Part 24.

11.3. Enclosure: free standing, with front access to components and wiring, NEMA Type 12.

11.4. Rating:

a. 230 volts and 2,400 volts, three-phase, 50 hertz, to match rating of motor.

b. Interrupting capacity: manufacturer's design \_\_\_\_\_ kva.

c. Suitable for controlling a 350 hp and a 40 hp, 230, 2,400 volt, three-phase, 50 hertz, synchronous motor.

11.5 Interlocks: prevent opening switch with breaker closed.

11.6 Control voltage: 230 volts a-c, obtain from integral control transformer or bus depending on voltage.

11.8 Provide means of manually adjusting motor power factor.

11.9. Overload elements: provide three.

11.10. Cable entrance: bottom.

11.11. Nameplates:

a. Material: black bakelite engraving stock, white core.

b. Lettering: engraved, approximately 3/16" high; wording subject to Contracting officer's approval.

11.12. Loss of Field: provide loss of field relaying.

11.13. Remote control: provide four each stations with:

a. Start stop pushbutton.

b. Motor running red lights.

c. Voltmeter with transfer switch for phase to phase reading.

d. Voltage adjusting rheostat.

## 12. GENERATOR SWITCHGEAR.

12.1. Type: indoor, metal-clad.

12.2. Rating:

a. 230 volts, three-phase, 60 hertz.

b. Interrupting capacity as required.

c. Suitable for controlling a 250 kilowatt, 230 volt, three-phase synchronous generator.

12.3. Standards: conform to NEMA Industrial Control Standard IC1-1965, Section III, Part 24.

12.4. Enclosure: free standing, with front access to components and wiring, NEMA Type 12.

12.5. Control voltage: 230 volts a-c, obtain from bus.

12.6. Wiring: all control wiring will be not less than AWG 14. All conductors will be identified between connection points using mylar type markers and referenced on drawing. Wiring terminations will be made using pressure

type lugs. Wire insulation will be no less than 30 mils thick, conductors used to span hinged locations shall be 65 strand extra flexible wire. 6

12.7. Instruments & Control: The panel shall contain the following:

- a. Generator circuit breaker
- b. Voltmeter
- c. Boltmeter switch
- d. Ammeter
- e. Ammeter Switch
- f. Frequency Meter
- g. Wattmeter
- h. Voltage control rheostat

12.8. Instruments: All instruments shall be of the semiflush mounted  $4\frac{1}{2}$ " rectangular with 250 degree normal scale conforming to NEMA standard EI-1. Instruments shall have an accuracy of two percent of full scale value. Moving elements shall be provided with zero adjustment readily accessible from the front of the instrument without disassembly. All instruments shall be designed for the voltage and frequency specified, shall be calibrated for the intended purpose. Scale divisions shall be such as to facilitate rapid, accurate readings.

12.9. Protection: provide time over-current protection.

12.10. Arrangement: provide one main air circuit breaker capable of interrupting the total load.

12.11. Cable entrance: bottom.

12.12. Nameplates:

a. Material: black bakelite engraving stock, white core.

b. Lettering: engraved, approximately 3/16" high; wording subject to Contracting Officer's approval.

13. METAL CLAD SWITCHGEAR

13.1. Type: indoor, metal-clad

13.2. Rating:

a. Voltages: motors, 2,400 volts and 230 volts, 50 hertz, three-wire three-phase. Generators, 230 volts, 60 hertz, three-phase three-wire and 120/208 volts wye, 60 hertz, three-phase four-wire.

b. Interrupting capacity as required

c. Bus capacity

13.3. Arrangement:

- a. Order of units, left to right, viewed from front, same for both units.
  1. Utility service motor
  2. Utility service generator power unit
  3. Utility service generator exciter unit
  4. Utility feeder cubicle with one main outgoing.
- b. Dimensions: manufacturer's standard.
- c. Arrange buswork and endpanels to permit future extension to either end of switchgear.

13.4. Utility Service motors:

- a. Provide equipment as follows:
  1. Insulated bus, three-phase amperage and voltage as required.
  2. Ground bus
  3. Power circuit breakers, voltage and amperage as required.
  4. Two potential transformers 2,400/120 volt for metering.
  5. Three current transformers for metering, size as required.
  6. AC ammeter, indicating scale as required.
  7. Switch, ammeter transfer three-phase.
  8. Wattmeter, three-phase, scale as required, for use with specified instrument transformers.
  9. Circuit breaker control switch with red and green indicating lights.
  10. Pushbuttons, momentary contact, "start-stop" for control of motor starter.



11. Three overcurrent phase relays.
12. One overcurrent ground relay.
13. Clamp type terminal for aluminum power cables.
14. Power factor meter.
15. Name plates, front and rear.
16. Provide supplementary compartments as required.

13.5. Utility service generator power units:

a. Provide equipment as follows:

1. Insulated bus, three-phase, amperage as required.
2. Ground Bus.
3. Power circuit breaker, size as required.
4. Potential transformers, 240/120 volt as required for metering and voltage regulation.
5. Three current transformers for metering, size as required.
6. AC Ammeter, scale as required, indicating
7. Switch, ammeter transfer, three-phase
8. Wattmeter, three-phase, scale as required, for use with specified instrument transformers.
9. Circuit breaker control switch with red and green indicating lights. Thirty kw generator may have molded case circuit breaker. Control switch not required. Auxiliary switch for indicating lights will be required.
10. Three overcurrent phase relays.
11. One overcurrent ground relay.
12. Clamp type terminals for aluminum power cables.

13. Nameplates, front and rear.
14. Voltmeter, indicating.
15. Switch, voltmeter transfer three-phase.
16. Frequency meter, indicating.

b. Provide supplementary compartments as required.

c. Instrument transformers for voltage regulation equipment are shown to indicate in tent. Provide transformers as required for voltage regulation system provided.

13.6. Utility Service Generator Exciter Unit:

a. Voltage regulator: to include RF 1 suppression.

b. Manual voltage control rheostat.

c. Manual adjustment resistor.

d. Automatic voltage control rheostat.

e. Automatic-manual voltage control switch.

f. Clamp type terminals for instrument transformers and excitation circuit conductors.

g. Nameplates, front and rear.

13.7. Power Circuit Breakers:

a. Type: air, three-pole, single throw, electrically operated, mobile frame mounted.

b. Ratings:

1. 2,400 volts

2. Continuous amperes, as required.

3. Momentary current, amperes as required.

4. Four second rating, amperes as required.

5. Minimum interrupting capacity MVA as required.

6. NEMA duty cycle: CO-15 -CO.

- c. Operating mechanism: stored energy.
- d. Control voltage: 125 or 250 volts a-c.
- e. Accessories:

- 1. Provide auxiliary contacts, interlocks and relays required.

- 2. Provide manual tripping device for each breaker.

- f. Breaker control wiring: in accordance with USAS (ASA) C37.11 Fig. 4, Diagram B3, with separate fusing of close and trip circuits.

- g. Interchangeability: breakers of like current rating shall be mechanically and electrically interchangeable.

#### 13.8. Instruments:

- a. Type: switchboard, long scale, taut-band suspension, rectangular, semi-flush mounted, General Electric Type AB-40, or equal.

- b. Finish: dull black

#### 13.9. Instrument and control switches:

- a. Type: rotary, enclosed, General Electric Type SB-1 or equal.

- b. Distinguish switch functions by distinctive shapes of handles as follows:

- 1. Breaker control switches: standard pistol grip.

- 2. Instrument transfer switches: knurled.

- 3. Others: oval.

- c. Provide each switch with nameplate.

#### 13.10. Instrument transformers

- a. Type: indoor, dry

- b. Ratings and ratios: as specified or shown.

c. Design: coordinate mechanical and thermal ratings with other apparatus in switchgear.

d. Potential transformers:

1. Draw-out with primary current-limiting fuses.

2. Provide a total of six spare fuses.

e. Rating: For use on 2,400 volts.

#### 13.11. Indicating lamps

a. Type; round, 125-volt d-c or 115 volt a-c as required, General Electric Type ET-16, or equal.

b. Provide color caps as specified.

c. Ship lamps in cartons separate from switchgear. Provide minimum of twenty-four spare lamps.

#### 13.12. Protective relays

a. Type: overcurrent, inverse time, General Electric IAC 51, or equal.

b. Instantaneous trip attachment: provide on feeder breaker overcurrent relays only.

c. Relay mounting: semi-flush draw-out.

#### 13.13. Alarms

a. Provide all auxiliary devices and internal wiring to actuate alarm system for automatic tripping of any breaker.

#### 13.14 Interlocks

a. Provide mechanical interlock to prevent removal or insertion of breakers while in the closed position.

b. Provide interlock on stored energy breakers which automatically discharges closing spring upon removal or insertion into switchgear compartment.

c. Provide electrical interlock to prevent closing generator breaker if motor supply breaker is open, and to trip generator breaker if motor supply breaker is tripped.

13.15. Accessories

- a. Manual positioning device.
- b. Maintenance closing lever.
- c. Testing and routine maintenance tools.

13.16. Circuit protection; provide fuses and fuse blocks for, but not limited to, following:

- a. Closing circuit of each breaker.
- b. Tripping circuit of each breaker; 35 amperes minimum.
- c. Provide twelve spare fuses for each size used.

13.17. Color of finish

- a. USAS (ASA) 61 light gray or manufacturer's standard if approved by Contracting Officer.
- b. Provide one quart of matching touch-up paint.

13.18. Nameplates

- a. General: provide for each switchgear cubicle (front and rear) and for all control switches, relays, secondary fuses and other devices as required.
- b. Material: black Bakelite engraving stock, white core.
- c. Lettering: engraved, approximately 3/16" high. Wording shall identify equipment served, subject to Contracting Officer's approval.

13. INSTRUCTION BOOKS AND SPARE PARTS LISTS

13.1 Instruction Book - The contractor shall furnish three, contracting officer approved, instruction books and include them in the shipment with the system. If this book is not available, installation instructions may be used until the complete and approved instruction book is available. Any temporary installation instructions furnished must be replaced with a copy of the complete and final instruction within 90 days after acceptance. The installation instructions shall

be bound into book form and given all the necessary information to put the set into operation. The book shall contain a schematic and connection wiring diagram, piping connections, starting instructions, voltage and frequency adjustments. These books shall contain complete instructions on the maintenance and operation of the set; a complete list of all parts, outline drawings giving: installation dimensions, weights, location of all external connections such as power lines, control connections. The manufacturer's parts book must be coordinated to cover the correct options and accessories as supplied on the unit. The manufacturer's part list covering each and every item used in building the set will be acceptable. Accessories may be covered by manufacturer's standard printed illustrative parts bulletin. Complete nameplate data shall be given for all equipment having nameplates. The book also shall contain a complete section relative to hints on servicing which might be of value to operators who are not mechanics. This should include the listing of parts which will require lubrication and servicing on a periodic basis, as well as suggestions to help in diagnosing and correcting minor troubles which might develop in the unit. Complete instructions will also be included in the procedure for disassembling and reassembling all parts of the generator and exciter. Complete information on adjustments, contact pressure, dropout and pickup voltage of all relays, the clearance fits of all the principal rotating or reciprocating parts, and the manufacturer's wear tolerances shall be included. This book shall show the original manufacturer's parts numbers, in addition to any numbers which the contractor may also assign. One additional set shall be delivered to the inspecting officer.

SPECIFICATION NO. 2-337-2-70

FOR SUBSTATIONS: UNIT TYPE MODIFIED INDOOR

1.1 Transformers

a. Unit one rating

(1) 300 KVA

(2) Primary: 11000 volts, three-phase, three-wire, 50 hertz, delta connected.

(3) Secondary: 230 volt three-phase, three-wire, 50 hertz, delta connected.

b. Unit two rating

(1) 750 KVA

(2) Primary: 11000 volts, three-phase, three-wire, 50 hertz, delta connected.

(3) Secondary: 2400 volts, three-phase, three-wire, 50 hertz, delta connected.

c. Unit three rating

(1) 500 KVA

(2) Primary: 2400 volts, three-phase, three-wire, 50 hertz, delta connected.

(3) Secondary: 230 volt, three-phase, three-wire, 50 hertz, delta connected.

d. Cooling: The 300 KVA and the 750 KVA will be oil immersed, non flammable askarel. The 500 KVA will be dry type.

e. Taps: two each 2½% above and two each 2½% below on primary. Not load tap changing.

1.2 Primary Switchgear

a. Fusing: Consisting of power fuses of a type suitable for use in metal clad switchgear mounted on a transformer. Provide six extra fuse links sized to be compatible with transformer.

b. Switching: Suitable for interrupting the magnetizing current of the transformer. Two each key interlocks to be provided to prevent opening this switch unless the two secondary breakers are in the open position.

c. Lightning protection: Provide arrestors mounted in the primary compartment compatible with the transformer.

d. Pothead: Provide a pothead, three conductor, with stress cone materials and compound. Cable specifications will be forwarded as soon as possible.

### 1.3 Secondary Switchgear

a. Cable entrance: bottom.

b. Metering: provide the following on each Askarel oil filled unit.

(1) Voltmeter

(2) Ammeter

(3) Wattmeter

c. Control:

(1) Voltmeter switch, phase to phase.

(2) Ammeter switch.

d. Protection:

(1) Time and instantaneous over-current tripping.

(2) Under and over voltage protection.

(3) Open phase protection.

e. Breakers:

(1) Air circuit breaker: rated at transformer capacity and main bus structure.

(2) Air circuit breaker: rated for 250 KW motor-generator set on 750 KVA transformer and rated for 30 KW motor-generator set on the 300 KVA transformer.



f. Connections: lugs and connectors shall be provided and suitable for aluminum conductors.

1.4 Fungus Protection: Provide fungus protection on all exposed parts that are subject to corrosion due to high humidity.

SPECIFICATION NO. 3 -337-2-70

FOR TRANSFORMERS

Transformer, dry type, single-phase 240 x 480 volt primary,  
120 x 240 volt secondary, 50 hertz, 37½ KVA 2 ea.  
(Contact GE on this. Not listed in Graybar 106)

Transformer, dry type, single-phase, 240 x 480 volt primary,  
120 x 240 volt secondary, 60 hertz, 37½ KVA General Electric  
9T23A2662 (or equal) Graybar pg. 892 cat 106) \$685.00 2 ea.